

## Section 10 - Software

This section contains information on the Workstation software and System Diagnostics. It is organized as follows:

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# Workstation Software Functions

The system operates almost entirely under software control. When you press a button or operate the Touch Screen, you are really writing data to control registers that software reads and acts upon. System software also generates responses to operator commands and generates operator messages. System response to control actuation is near real time; that is, it is not visibly slower than what would occur with hard-wired controls.

Software's response to control actuation depends on the current operational mode, system configuration, and a number of other variables. This results in precise, accurate system control and monitoring, which does much to improve the speed, safety, and accuracy of system operation. The software performs many checks to make sure it is safe to the patient, operator, and equipment before generating X-rays.

System software executes on the Host Pentium motherboard, and while the system is on, it communicates with a number of intelligent system PCBs in the Workstation and in the external equipment over the ARCNet, exchanging commands, status information and data with these PCBs. Configuration information remains in flash RAM during power-down periods. Configuration data can be overwritten by the Remote Utilities Tool and system software.

The more you understand about the software's features and characteristics, the better you'll be able to troubleshoot the system.

## Security

System software provides these three security features:

- The system software cannot be accessed or changed by the user.
- The user cannot access any internal disk operating system functions.
- The software performs tests during system initialization that determine if the software is loaded correctly.

### Bootup

The following paragraphs describe bootup events for the Workstation. To observe a reasonably complete bootup sequence, you'll need to connect your VGA debug monitor to the VGA port on the rear panel of the Workstation. Other boot sequence events and messages appear on the Workstation monitors. The boot sequence can vary slightly from system to system depending upon configuration.

### Time Required

Normal boot-up time for the system is about 80 seconds.

### Boot Sequence Example

The Workstation boot sequence depends on system configuration. Event sequence differs according to model and installed options. The following example shows typical boot information you can see on the service monitor as the system boots. The example shows the Left Monitor displays followed by an explanation of each display.

### Debug Monitor Boot Screen #1

```
WS_INIT: *****
WS_INIT:                OEC Medical Systems Inc.
WS_INIT:  PN879130-xx - Sep  9 1999 - 13:09:32
WS_INIT:  Copyright (c) 1993-1994 ATI - Nucleus PLUS - 386/486 Nucleus PC 1.5.G1.1+
WS_INIT:  The Current Time is: 9/15/1999 - 16:8:20
WS_INIT:  *****
```

## Software

### Explanation:

This block provides the part number of the release PN879130-XX. XX is the dash number, the date the release was built, and the date of the last boot.

### Debug Monitor Boot Screen #2

```
WS_INIT:  WORKSTATION INITIALIZATION BEGINS
FFB_NETI: My DiagStat was 30 and Recon Count = 0
GEN_NETI: My DiagStat was 30 and Recon Count = 0
WS_NETI:  My DiagStat was 72 and Recon Count = 1
```

### Explanation:

This block shows that the processors on the Fluoro Functions PCB, the X-Ray Controller PCB, and the Systems Interface board booted correctly, and that ArcNet node mapping has occurred. If the Recon Count is high there may be a problem with one of the processors or the ArcNet.

### Debug Monitor Boot Screen #3

```
FW_UTIL:  No Download Pending
```

### Explanation:

This block shows that the FFB, the X-ray controller and the System Interface processors have had their programs loaded and are ready to initialize. If code needs to be loaded, there will be messages showing what processor is loading and what block in that process is loading.

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### **Debug Monitor Boot Screen #4**

```
WS_INIT:  Waiting for Analysis Tasks Ready
WS_INIT:  SubSystem Initialization Started
WS_INIT:  *** 30 FPS SYSTEM ***
```

#### **Explanation:**

Shows the Workstation is initializing and that the system is a 30 frame per second CINE system.

### **Debug Monitor Boot Screen #5**

```
WS_TIMR:  WS   Min:   8   Secs: 28   FSyncs: 0           RTC Secs: 28
```

#### **Explanation:**

Real Time Clock Setting

### **Debug Monitor Boot Screen #6**

```
WS_TIMR:  Time Sent to GEN
WS_TIMR:  Time Sent to FFB
WS_TIMR:  Time Sent to SRV
```

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### Explanation:

Indicates that the Workstation, the X-Ray Controller, the Fluoro Functions PCB and the System Interface processors are communicating. Clocks are synchronized on all of the ArcNet nodes.

### Debug Monitor Boot Screen #7

```
FW_UTIL:  Checking Version Data
FW_UTIL:  Checking Version Data
FW_UTIL:  Checking Version Data
```

### Explanation:

Compares the Workstation software version with the Generator software version. The Workstation and the Generator need to run the same version level.

### Debug Monitor Boot Screen #8

```
WS_INIT:  Initializing DCTL
```

### Explanation:

Initialization of the Display Adapter Controller

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### **Debug Monitor Boot Screen #9**

WS\_INIT: Showing OEC Logo

#### **Explanation:**

The OEC logo should appear on both the left and right monitors shortly after this message appears.

### **Debug Monitor Boot Screen #10**

WS\_INIT: Human IF Screens Initializing

#### **Explanation:**

All the screens and menus that the user will see are becoming ready to use.

### **Debug Monitor Boot Screen #11**

WS\_INIT: Human IF Control Panel Initializing

#### **Explanation:**

All the buttons and keyboards that the user will see are becoming ready to use.

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### **Debug Monitor Boot Screen #12**

FW\_UTIL: No Download Pending

#### **Explanation:**

Same as previous message

### **Debug Monitor Boot Screen #13**

WS\_INIT: SIO DOMAIN Initializing

#### **Explanation:**

The code that controls serial I/O (monitor brightness and contrast) is loading.

### **Debug Monitor Boot Screen #14**

WS\_INIT: Video Controller PIO DOMAIN Initializing

#### **Explanation:**

The code that controls the hardware in the Image Processor, the Video Controller, and the Display Adapter is loading.



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### **Debug Monitor Boot Screen #15**

```
DAP_CMP: Loading dose tables
DAP_CMP: iris indexes:  0.00 18.57 32.85 47.14 61.42 72.85 81.42 90.00
DAP_CMP: shutter indexes: 0.00 16.14 28.82 41.12 53.80 63.79 71.09 78.78 86.47 98.00
DAP_CMP: Dose table loaded
```

#### **Explanation:**

The system is loading the Dose Area Product calibration tables.

### **Debug Monitor Boot Screen #16**

```
WS_INIT: DP Initialization Started
```

#### **Explanation:**

The controlling software for the Image Processor, the Video Controller, and the Display Adapter is loading.

### **Debug Monitor Boot Screen #17**

```
WS_INIT: Application Initialization Started
```

#### **Explanation:**

The system application software is loaded.

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### **Debug Monitor Boot Screen #18**

CINCINE: Cine Initialization Started

#### **Explanation:**

The Cine Disk subsystem and disks are being initialized.

### **Debug Monitor Boot Screen #19**

CINCINE: Cine Initialization Completed

#### **Explanation:**

The Cine Disk subsystem initialization is complete.

### **Debug Monitor Boot Screen #20**

GEN\_CI: Iris is Calibrated  
GEN\_CI: Collimator Min Value Set  
GEN\_CI: Collimator Max Value Set  
GEN\_CI: Leaf rotation is calibrated  
GEN\_CI: Leaf opening is calibrated  
GEN\_CI: Camera Rotation is calibrated

#### **Explanation:**

Collimator calibration data is transferred from the X-Ray Controller Flash memory to Fluoro Functions PCB system memory.

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### **Debug Monitor Boot Screen #21**

GEN\_CI: Waiting for Mag Mode Event for Home Picture

#### **Explanation:**

Not displayed if RETAIN LAST was selected in the Workstation's Customize menu.

### **Debug Monitor Boot Screen #22**

WS\_INIT: DEC21143 20C6 0 32002000

#### **Explanation:**

Ethernet card initialization is complete.

### **Debug Monitor Boot Screen #23**

WS\_INIT: DICOM Init Complete Speed = 14

#### **Explanation:**

DICOM code initialization is complete. Speed = 14 means 100 BaseT

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### **Debug Monitor Boot Screen #24**

WS\_INIT: Serial Number 89-0007

#### **Explanation:**

Provides the system serial number.

### **Debug Monitor Boot Screen #25**

WS\_INIT: SubSystem Initialization Complete

#### **Explanation:**

Bootup is complete.

### **Debug Monitor Boot Screen #26**

CAM\_DAT: Camera Cooler Data Sent

#### **Explanation:**

Camera cooler duty cycle table has been sent from the Workstation to the Fluoro Functions PCB memory.

### Workstation Defaults

After normal bootup, the Workstation defaults to the following conditions:

#### Monitors

- Right-hand monitor displays the **Patient Information Screen**.
- Left-hand monitor displays OEC Medical Systems logo.

## Software

### Workstation

- Auto Contrast and Brightness are both ON.
- Auto Swap is OFF.
- Auto Save at end of exposure is OFF.
- Auto Playback When Cine Acquired is ON.
- Cine Acquire is OFF in both Fluoro and HLF modes.
- Crop is OFF.
- The date format is MM/DD/YYYY.
- Dose Units are in mRad.
- Edge Enhance is ON.
- Landmark is OFF but enabled.
- Mode is Standard Fluoroscopy.
- Negate is OFF.
- Noise Filtering is ON and set to 8.
- Peak Opacify is OFF.
- Pulse/Continuous is set to Continuous.
- Re-registration is OFF but enabled.
- Zoom is OFF.

### Other Initial Conditions

- If your system is equipped with a Cine disk system that fails to initialize during system boot, the following message appears: **CINE DISK FAILURE**.
- If the Touch Screen fails to initialize during system boot, the following message appears: **TOUCH SCREEN FAILURE**. This failure could be caused by a cable being disconnected, or by a serial interface problem.
- If an LED is burned out on the Touch Screen, or if there is something blocking an LED on the screen, the following message appears: **TOUCH SCREEN OBSTRUCTION**.
- If your system is equipped with DICOM and the Workstation cannot establish a network connection with the DICOM server, the following message appears: **CANNOT MAKE NETWORK CONNECTION**.
- If the Keyboard fails to initialize during system boot, the following message appears: **KEYBOARD FAILURE**. This failure could be caused by a cable being disconnected, or by a serial interface problem.
- During system initialization, the software makes a compatibility check between the Workstation and generator by comparing version labels. If the Workstation and generator are incompatible, the following message appears: **WORKSTATION AND GENERATOR ARE NOT COMPATIBLE**.
- If your system is equipped with a Jaz disk drive and that drive fails to initialize correctly, the following message appears: **HIGH CAPACITY DISK FAILURE**.

### Workstation Messages

The following is an alphabetized list of messages that may appear on the right-hand Workstation monitor. Some messages appear as a result of start-up failure or failure during operation of the system. Other messages appear during normal operation of the system. Workstation failures may result in impaired system operation or automatic system shutdown. Clear a message from the Workstation monitor by touching the **OK** button on the right-hand monitor.

**CANNOT MAKE NETWORK CONNECTION** - This message appears when a DICOM-equipped Workstation cannot establish communications with the DICOM server. Solutions: Verify that the Workstation is connected to the network. Check DICOM connection internally and externally. Check DICOM PCB. Ask System Administrator to check DICOM server.

**CINE DISK FAILURE** - During system boot-up the system issues an initialization command to the Cine disk subsystem. This message appears when the Cine disk subsystem fails to initialize correctly.

**CINE PLAYBACK NOT AVAILABLE** - When the Jaz disk is the **COPY FROM** source and you select a Cine run mini-image from the **IMAGE DIRECTORY** screen, this message appears on the right monitor.

**COPY OR PRINT IN PROGRESS** - Please wait.

**DICOM SERVER IS OUT OF RESOURCES -- TRY AGAIN LATER** - This message appears when the DICOM server is busy. If the message persists, ask the system administrator to check the DICOM server.

**DISK FORMAT IS IN PROGRESS** - This message appears when the currently selected COPY TO device is being reformatted.

**DISK FULL** - This message appears during a copy process when the destination disk (or diskette) has insufficient room for the new data. Touch the **CANCEL** button to terminate the copy in progress, or insert another diskette and touch the **OK** button to resume the copy.

**FORMATTING ERASES ALL DATA ON THE DISK** - You will see this message when you touch the **REFORMAT** button on the **COPY FORMAT** screen. It's just a friendly reminder that the disk formatting you're about to do is serious business that is not reversible.



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**HIGH CAPACITY DISK FAILURE** - This message appears during system bootup when the Jaz disk drive fails to initialize correctly due to incorrect installation or other failure. Solutions: Check cabling. Check configuration. Check SCSI controller PCB.

**INVALID YEAR** - This message appears when you make an invalid entry in the **CUSTOMIZE DATE/TIME** screen. You must enter a value from 1976 to 2075.

**KEYBOARD FAILURE** - This message appears during bootup when communications between the Workstation and Workstation keyboard is not established. Solutions: Reboot Workstation, keeping power off for five seconds. Check keyboard cabling. Check Control Panel Processor PCB.

**NO DISK IN DRIVE** - When you are preparing to copy to a Jaz drive or to a floppy disk, the system checks to see if a disk is actually mounted in the drive. If no disk is present, the system generates this message.

**PLEASE WAIT** - The system displays this message when it needs more time to complete a print or a copy.

**PRINT FORMAT NOT SUPPORTED** - The Workstation displays this message when you send a document to the printer in a format that the printer doesn't understand. Solutions: Use the CUSTOMIZE menu to select a compatible format. Contact the network administrator for assistance.

**PRINTER ERROR** - This message appears when the printer reports a hardware error condition to the system. Solution: Check the printer for a displayed error message, and refer to printer's operating instructions for more information.

**PRINTER IS OUT OF FILM OR PAPER** - This message appears when the printer notifies the system that it is out of film or paper.

**PRINTER NOT RESPONDING** - When you send a job to the printer, the system expects a response before printing begins. You'll get this message if the system doesn't get a response from the printer.

**PRINTER OFF-LINE** - This message from the printer appears when you send data to be printed, but the printer is off line. Place printer on-line and resubmit the print job.

**REMOTE CONTROL BATTERY IS LOW** - The handheld Workstation remote control continually monitors its battery for adequate charge and reports this information to the Workstation. This message appears on the Workstation monitor when battery charge is too low to reliably operate the remote.

**SYRINGE ICON** - The syringe icon appears on the Workstation monitor when it is time to inject contrast media.

**SYSTEM ERROR DETECTED** - This message appears when the system detects an error condition. The usual response is to restart the system to clear the error condition.

**THE CINE DISK IS NOT AVAILABLE** - This message appears when the Cine Disk is inoperative or incorrectly configured. Solutions: Use RUT to check Cine status. Check cabling. Check Cine drive(s) and Cine power supplies.

**THE CINE DISK IS OVERHEATING** - Software monitors a thermistor in the Cine Disk subsystem to determine disk temperature. If the thermistor reports back a temperature over 55°C ( $\pm 5\%$ ), the system displays this message.

**THE CURRENT CINE RUN WILL FILL THE CINE DISK IN APPROXIMATELY 30 SECONDS** - Cine acquisition stops when the current run fills the disk(s). This message appears when 30 seconds before that happens.

**THE CURRENT SESSION CINE RUNS WILL BE OVERWRITTEN IN 30 SECONDS** - If you're doing a cine run and you're half a minute or less from running out of Cine disk space, this message appears. If you continue with Cine acquisition, the system overwrites the oldest Cine Disk files first.

**TOUCH SCREEN FAILURE** - If the Touch Screen fails to initialize during bootup, this message appears on the Workstation monitor. Reboot the system (leaving power off for at least five seconds) to clear this error. If the error persists, check cabling and power to the Touch Screen hardware.

**TOUCH SCREEN OBSTRUCTION** - This message appears if the Touch Screen fails during system bootup due to an inoperative LED or phototransistor, or if a physical blockage of the touch screen's infrared beams exists. For example, an object lying on the Workstation keyboard could extend over the Touch Screen bezel and block one or more infrared beams. Reboot the system (leaving power off for at least five seconds) to clear this error. If the error persists, check cabling and power to the Touch Screen hardware, and check Touch Screen hardware for damaged components.

**UNKNOWN PRINTER MODEL** - If you try to configure the system to use a printer it doesn't support or is not configured to support, you're going to get this message. Use the CUSTOMIZE screen to make sure the system is correctly configured for the installed printer.

**VCR COMMUNICATION FAILURE** - This message appears when the system can't communicate with the VCR to play back or record images. Reboot the system (leaving power off for at least five seconds) and try again. If message persists, make sure VCR cabling is OK. Make sure VCR is powered up.

## Software

**WORKSTATION AND GENERATOR ARE NOT COMPATIBLE** - This message appears during the boot process if the Workstation software and Generator software are not compatible. You cannot generate X-rays under these conditions, but you can operate the Workstation independently.

**WORKSTATION IS OVERHEATING** - This information will be supplied in a future version of this manual.

**WORKSTATION KEYBOARD ERROR** - This message identifies an error in the serial communications between the Workstation and the Workstation Keyboard. Reboot the system (leaving power off for at least five seconds) and try again.

### Image Processing

The system performs a number of automatic procedures that enhance and clarify images. The following paragraphs discuss these procedures.

#### Image Input Filter

Image input filtering consists of CCD Camera Correction and Input Gamma Correction.

System software performs CCD Camera Correction by sampling the CCD on a regular basis and making adjustments to compensate for variations in pixel gain and offset, and for pixels that may be inoperative. These types of imperfections are normal in charge-coupled displays.

CCD camera response to light is more linear than it was with the vidicon camera tube. However, the vidicon response provides an image that is more suited for the human eye. Input Gamma Correction is a software function that alters the video from the CCD camera logarithmically to make it more pleasing to the eye.

#### Log/Antilog

A subtracted image shows better detail if both the mask image and incoming live images are filtered to a natural logarithmic scale. However, if an image that has been processed with a log function is directly displayed as a Fluoro image, it appears bright and unpleasant to look at. System software automatically performs both the log and antilog filtering to help keep image quality acceptable.

#### Motion-Actuated Noise Reduction System (MANRS)

This software function reduces motion artifacts (smearing) in an averaged image by adjusting the amount of averaging it applies to input frames in real time. At lower averaging levels, MANRS uses a larger part of the current input frame to create the next processed video frame.

## Software

### Dose Area Product

System software calculates and accumulates Dose Area Product (DAP) for the current patient and displays this information every half second on the left monitor while X-rays are on. DAP is a measurement of the radiation released from X-ray tube/collimator assembly; it is not a measurement of the radiation dose absorbed by the patient.

### Video Level Indicator (VLI)

Video Level Indication; a digital representation of the CCD camera's current video level. The system servo camera gain until VLI reaches an acceptable value.

## Management Functions

System software manages several Workstation functions, as described in the following paragraphs.

### Store and Read Brightness and Contrast Data Files

Software stores brightness and contrast calibration values for the left and right monitors in nonvolatile memory. The system uses these values at power-up to set proper brightness and contrast values for each monitor.

## Software

### Manage Workstation Options

System software generates interfaces with most installed Workstation options including:

- DICOM
- Jaz Drive
- Onboard (Codonics) Printer
- Infrared Remote
- Video Cassette Recorder

The system has hardware-only interfaces for the Lenzar camera, Sony 960 Thermal Printer, and Sony 980 Printer. Just press the **EXPOSE** or **Print** key to copy the current image on the left monitor. Use control panel keys on the individual devices to perform other functions.

### Manage Service Port

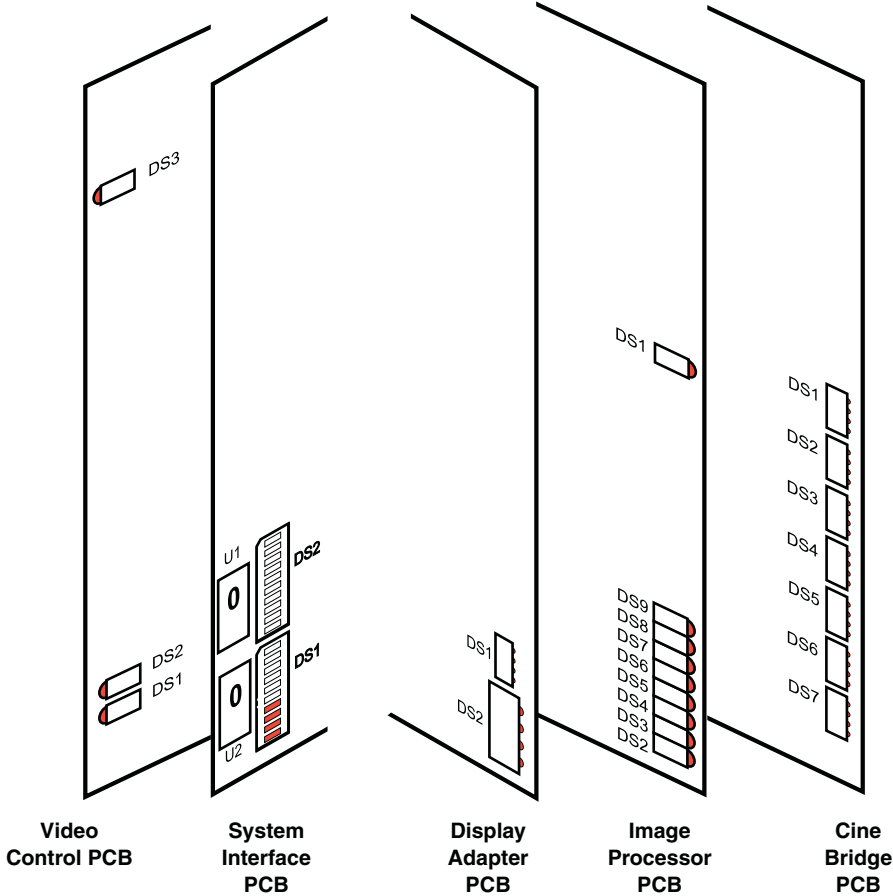
System software manages RS-232 communications between the 15-pin ARCNET connector on the rear panel of the Workstation and the serial port on the laptop computer. Management includes handshaking, security measures, command conventions, etc.

### PCB Diagnostic LEDs

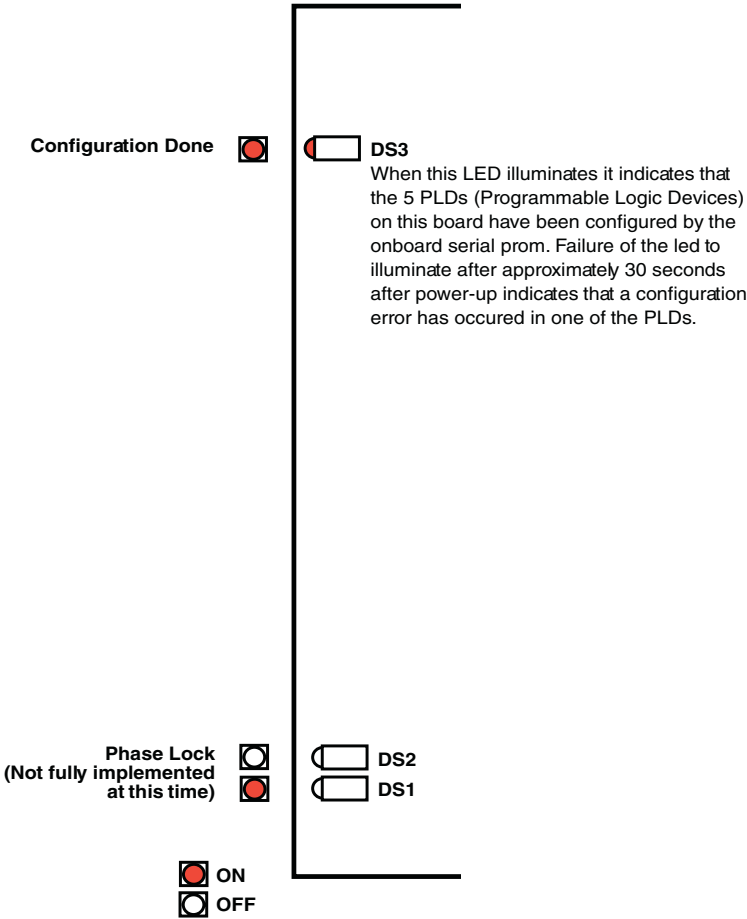
The following illustrations show LEDs on Workstation PCBs that can be used for troubleshooting purposes. All of these PCBs reside in the Workstation, and mate with an ISA or PCI slot on the Host Pentium CPU motherboard as shown in the next figure.

A simplified illustration of the location of these PCBs is shown next, followed by an illustration of the LEDs on each PCB.

Some of the LEDs don't change state during system operation. Others turn on and off with normal system activity. Other LEDs come on only when the circuit they monitor is faulty.

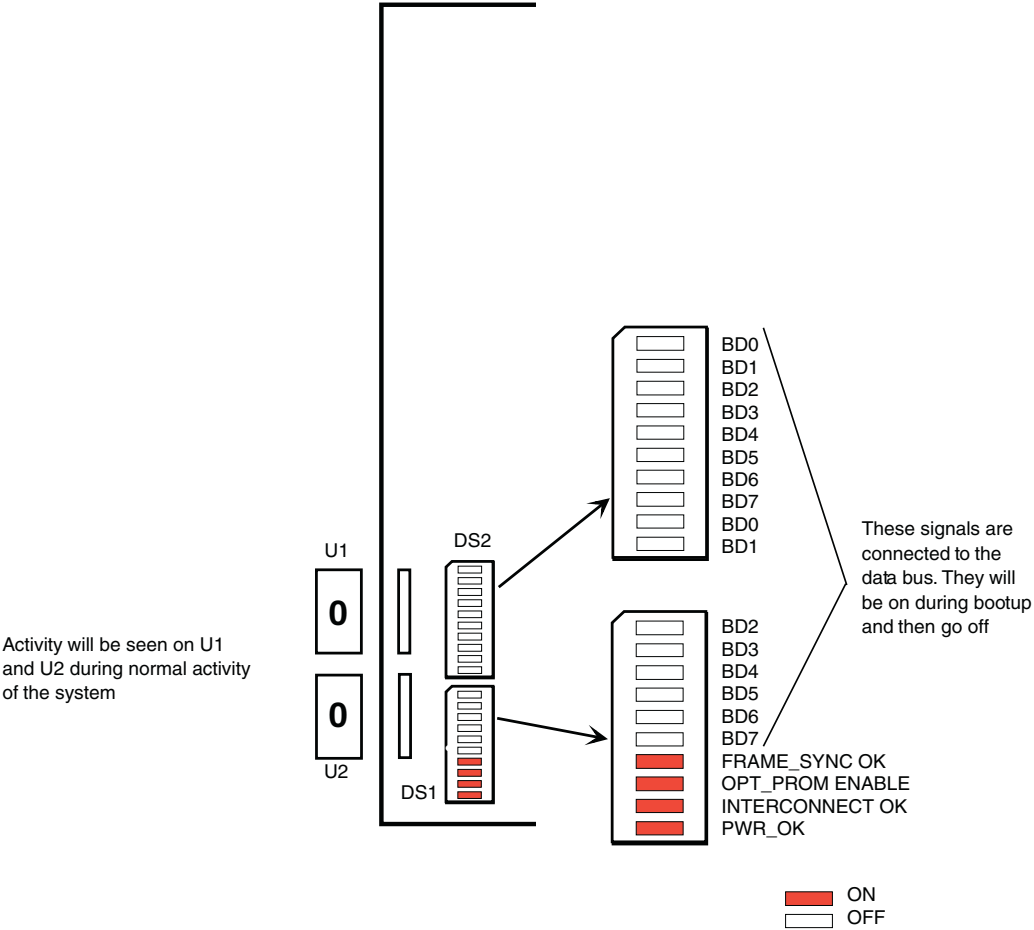


Workstation LED Locations

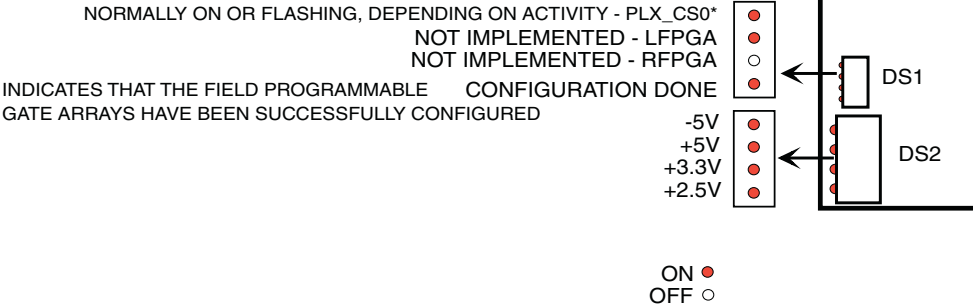


Video Controller LEDs





System Interface LEDs



Display Adapter LEDs

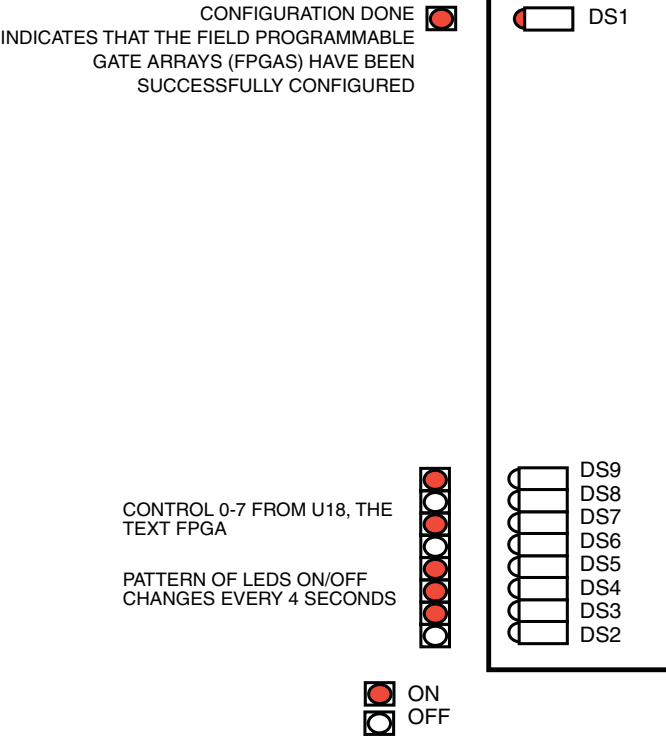
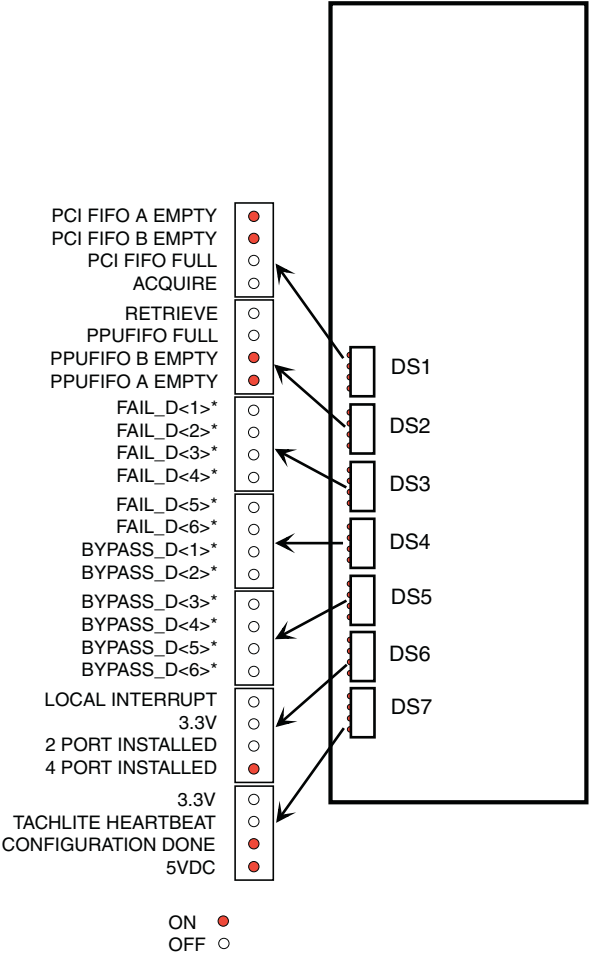


Image Processor LEDs



Cine Bridge LEDs